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FLOOD INSURANCE STUDY

ORIGINAL

CITY OF ENGLEWOOD, NEW JERSEY
BERGEN COUNTY

FEBRUARY 19, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 340031

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

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FLOOD INSURANCE STUDY
CITY OF ENGLEWOOD, NEW JERSEY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Englewood, Bergen County, New Jersey, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for Flat Rock Brook and Tributary to Overpeck Creek were prepared by the New Jersey Department of Environmental Protection for the Federal Emergency Management Agency (FEMA), under Contract No. H-4546. This work was completed in November 1979. The hydrologic and hydraulic analyses for Overpeck Creek and Metzlers Creek and the tidal analyses for Newark Bay were prepared by Dewberry & Davis, under agreement with FEMA. This work was completed in March 1984.

1.3 Coordination

Streams requiring detailed study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA, the City of Englewood, and the New Jersey Department of Environmental Protection (the study contractor).

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A search for basic data was made at all levels of government. In January 1978, a letter was submitted to the mayor and town engineer of Englewood requesting any available stream data, topographic mapping, information related to past flood problems, flood protection measures that have been implemented or are being planned within the city, and any other information which the city would like incorporated into the study.

An intermediate CCO meeting was held in April 1979 attended by representatives of FEMA, the study contractor, URS/MSR Engineers, and the city. Preliminary delineations were reviewed and commented upon at this meeting. On May 14, 1981, the results of the study were reviewed at a final CCO meeting held with representatives of FEMA, the city, and the study contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Englewood, Bergen County, New Jersey. The area of study is shown on the Vicinity Map (Figure 1).

Overpeck Creek, Tributary to Overpeck Creek and Metzlers Creek were studied by detailed methods for their entire lengths within the community. Flat Rock Brook was studied by detailed methods for 1.3 miles upstream of the downstream corporate limits. Tidal flooding from Newark Bay affecting Overpeck Creek was also studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through March 1989.

Tributary to Flat Rock Brook, East Brook Branch, and the remaining portion of Flat Rock Brook were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Englewood.

2.2 Community Description

The City of Englewood is located in the east-central portion of Bergen County in northwestern New Jersey, approximately four miles northwest of the George Washington Bridge. It is bordered by the Boroughs of Bergenfield and Tenafly to the north, the Boroughs of Fort Lee and Englewood Cliffs to the east, the Boroughs of Fort Lee and Leonia to the south, and the Township of Teaneck to the west.

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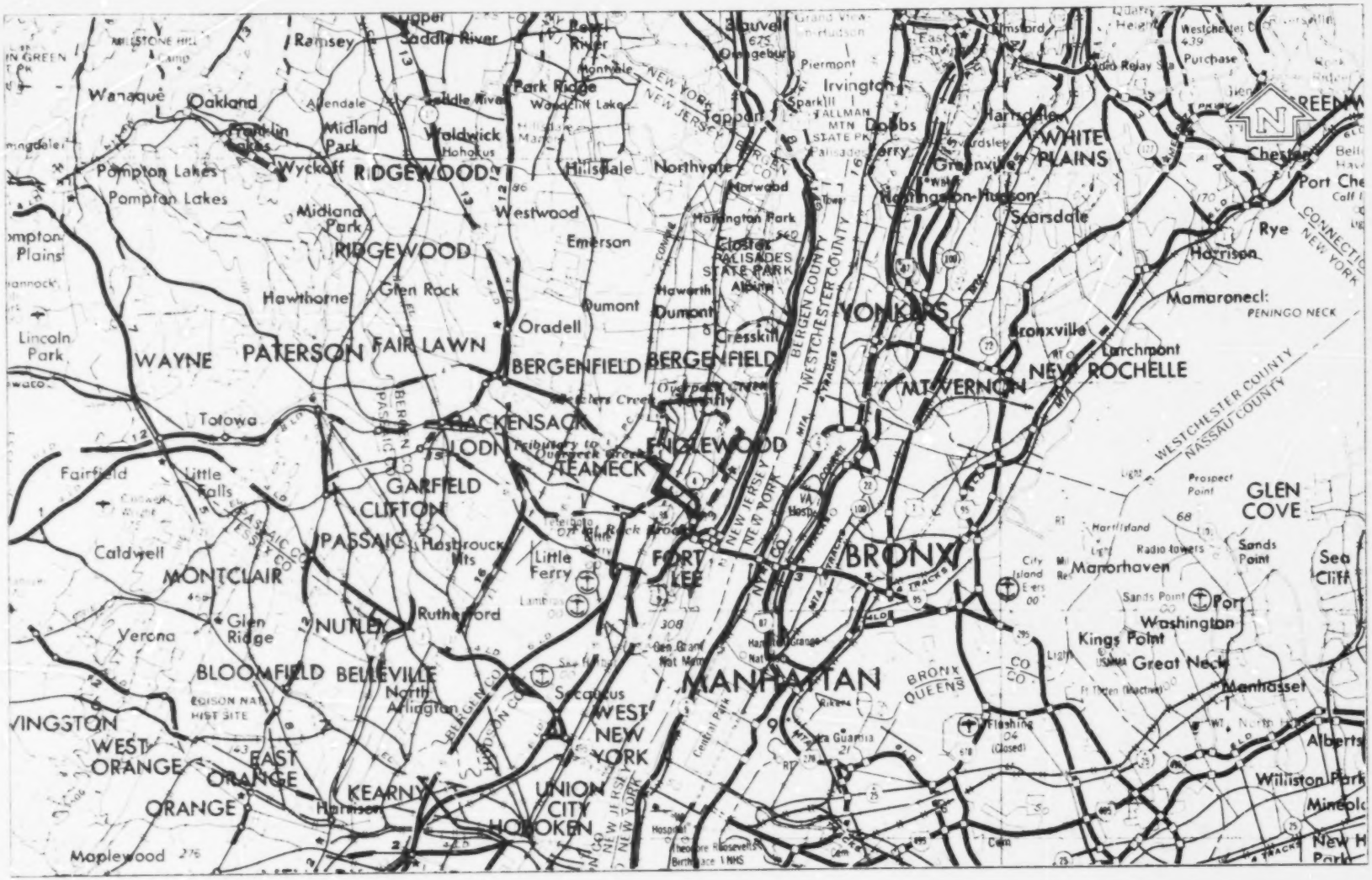

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

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Like most of southeastern Bergen County, Englewood traces its history back to 1668 when the Hackensack Indians deeded tracts of land to settlers. This area became known as the English Neighborhood and stretched from Ridgefield to Closter. In 1840, the area was connected by railroad to Jersey City and began to develop. In 1859, J. Wyman Jones purchased 625 acres, laid out streets and registered a map of the Town of Englewood. In 1879, Englewood became an incorporated city. With the opening of the George Washington Bridge in 1931, the population of the city increased, and the area developed rapidly. Today the city is, for the most part, fully developed.

Englewood has a population of approximately 25,000 persons and is far more diverse in terms of wealth, occupation, and race than the surrounding area. In addition to being a residential community, there are also 400 commercial businesses and professional firms and nearly 150 industries.

The city is located adjacent to the massive highway system which traverses northeastern New Jersey. The major roads within the city are State Route 4, Dean Street, Palisades Avenue, and Grand Avenue-Engle Street.

Englewood is situated within the southern part of the northern valley of Bergen County, just north of the Hackensack Meadows. The city occupies 4.9 square miles along the western face of the Palisades. The western portion of the city is generally low and level, while the eastern section slopes up sharply to the height of the Palisades. Overpeck Creek, a tributary to the Hackensack River, flows through the residential and commercial valley section of the city, while Metzlers Creek flows from the City of Bergenfield and drains the western residential area before joining Overpeck Creek. The southeastern areas of the city are drained by Flat Rock Brook.

The climate of the area is characteristic of the mid-Atlantic Seaboard. Marked changes of weather are frequent, particularly during the spring and fall. The winters are moderate, with about 32 inches of snowfall, and the summers are hot with occasional thunderstorms. The average annual temperature is about 54 degrees Fahrenheit (°F), with yearly extremes ranging between -10°F and 100°F. Rainfall patterns are fairly consistent, with an average annual precipitation of 44 inches. August is generally the wettest month of the year, and January is usually the driest.

2.3 Principal Flood Problems

The major source of flooding in Englewood is Overpeck Creek. From the downstream corporate limits to the confluence of Metzlers Creek, the

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flood plain consists primarily of industrial and commercial establishments. Upstream from this point, the majority of the flood plain is residential.

Flooding along Metzlers Creek and Flat Rock Brook causes damage to residential structures. Since the city is highly developed, frequent flooding results from undersized storm sewers and a natural bowl-like topography in some of the overbanks.

Most recently, the storm of November 8, 1977, produced severe flooding in Bergen County. According to a U. S. Geological Survey (USGS) report on this storm, the damage in Bergen County amounted to approximately $62 million (Reference 1). The New York District of the U. S. Army Corps of Engineers (COE) assigned a 56-year recurrence interval to this flood (Reference 2).

2.4 Flood Protection Measures

During the storm of November 8, 1977, the Overpeck Creek tide gates, located near the New Jersey Turnpike Bridge in Ridgefield, New Jersey, were inoperable. The tide gates have been renovated to provide more efficient protection from flooding.

A flood control project for Overpeck Creek from State Route 4 to West Forest Avenue has been completed. This project included channelization of the creek and construction of concrete retaining walls designed to contain the 100-year flood. Potential flooding along State Route 4 has been diminished; however, flooding along West Forest Avenue can still be a problem.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40

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percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for the flooding sources studied in detail affecting the community.

For Metzlers Creek, the hydrology was developed using a log-Pearson Type III analysis of the USGS gage (No. 01378590) on Metzlers Creek. The analysis followed guidelines established by the Water Resources Council (Reference 3). The discharges were computed for drainage area increments using the following USGS discharge transfer equation:

$$Q_1/Q_2 = (DA_1/DA_2)^x$$

where Q_1 is the known discharge, Q_2 is the incremental discharge, and DA_1 and DA_2 are the known drainage areas. The transfer coefficient "x" was developed for each frequency to reflect specific drainage basin characteristics in this area. The transfer coefficients for the 10-, 50-, and 100-year discharges were 0.68, 0.65, and 0.63, respectively. The 500-year incremental discharge was developed by graphical methods.

The Overpeck Creek hydrology was computed to reflect the changing drainage area along the stream. A graphical relationship of discharges to drainage area was compiled. The data were derived from three USGS gages with drainage basin characteristics similar to Overpeck Creek. Discharges for specific drainage area locations were taken from the graph.

The hydrology for Tributary to Overpeck Creek and Flat Rock Brook was developed using statistical analyses and parameters according to the method described in USGS Special Report 38 by Stephen J. Stankowski (Reference 4).

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

The coastal engineering analyses for this study was based on previous studies in the mid 1960s. Because of the different conditions of areas located at and inland from the mouth of the Hackensack River, the

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TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
OVERPECK CREEK					
Upstream of the confluence of Flat Rock Brook	8.1	910	1,310	1,490	1,960
Upstream of the confluence of Tributary to Overpeck Creek	5.7	760	1,090	1,200	1,600
Upstream of the confluence of Metzlers Creek	3.0	530	750	830	1,100
TRIBUTARY TO OVERPECK CREEK					
At its confluence with Overpeck Creek	1.0	275	445	545	810
METZLERS CREEK					
At its confluence with Overpeck Creek	2.4	453	625	704	995
FLAT ROCK BROOK					
At its confluence with Overpeck Creek	2.5	665	1,075	1,315	1,980

analyses were divided in two parts: the frequency analysis of tides at Upper Newark Bay and the frequency analysis and flood level delineation in the Meadowlands.

These studies were primarily aimed at determining the 100- and 500-year flood elevations in the areas of interest. For this, frequency distributions for high tides at the Battery, New York, and East Newark, New Jersey, were obtained. Additional studies were used to obtain the 10-year flood elevations inside the Meadowlands.

The following was performed for the Battery, New York, portion of the study. The recorded tide is the result of the astronomic (or predicted) tide and the meteorologic component, usually referred to as the surge. This component is produced by wind shear on the ocean surface of the continental shelf off New York Bay and by the local atmospheric pressure drop produced by the storm. The influence of the astronomic tide on the magnitude of the surge is assumed negligible, and the two components are considered statistically independent events. Consequently, the occurrence of any combination of magnitudes of the two components is considered a random event (Reference 5).

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A disaggregation program was written to separate the two components for a given recorded tide, using the known astronomic tide sequence. This results in the determination of the surge ordinates.

The astronomic tide may be obtained from tide tables or from a computation using the harmonic tide equation (Reference 6). However, this tide is referenced to mean sea level, which has long-term and seasonal variations. Therefore, a correction must be included to reference the astronomic tide to the National Geodetic Vertical Datum of 1929 (NGVD). Sea level in the vicinity of New York has been rising during this century at the rate of approximately 1.2 feet per century, so it now is approximately 0.6 foot above its 1929 level, which was used to define NGVD. However, yearly variations in mean sea level may vary considerably from the long-term trend and, therefore, when disaggregating the tide for a given storm event, attention was given to the recorded sea level for the year of occurrence.

Seasonal sea level variations were superimposed on long-term variations. In the New York area, the median predicted high tide for January is 0.66 foot below the median high tide for September. Seasonal mean sea level variations were incorporated in the equations used to compute the astronomic tide, so there was no correction to be made in this regard for the present disaggregation study. The analysis was prefaced by an inspection of historic storms as recorded by the National Weather Service and the COE. A total of 563 northeasters were analyzed for the period between 1926 and 1976. In addition, a total of 22 hurricanes were similarly analyzed for the period between 1963 and 1976. The storms were selected according to their track positions as probable candidates for surge production. These storm analyses were added to those made for hurricanes occurring in the period beginning in 1926 (References 7, 8 and 9).

Separate frequency distributions for northeaster and hurricane surge peaks were obtained by ranking the surge peaks obtained from the disaggregation studies. To describe the development of the surges, standard sequences of surge heights were used. These expressed the history of the heights in terms of the surge peak. The duration of each sequence was assumed equal to 48 hours for northeasters and 17 hours for hurricanes.

The northeaster surge sequence was developed for this study after an analysis of the largest recorded surges, corresponding to the 1950 and 1953 northeasters, as obtained by the New York District of the COE. The hurricane surge sequence was obtained from previous studies and has been used extensively (References 7 and 10).

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The assumption that each type of storm would have a standard surge sequence permitted the determination of surge heights during the development of the storm tide in proportion to the surge peak. Consequently, the surge peak frequency was considered applicable to the sequence as a whole.

The storm tide is the sum of the surge heights and the astronomic tide. Since these are statistically independent events, the probability of occurrence of any combination of astronomic tide and surge must be obtained by a joint frequency analysis.

The astronomic tide was represented by a sine-curve with a period of 12.4 hours (semi-diurnal). Its elevations, with respect to the prevailing mean sea level, were considered dependent on the tidal range (spring to neap) and time during the tidal cycle. These are the two most relevant variables characterizing the astronomic tide. Consequently, the frequency of occurrence of a storm tide elevation was obtained from the product of the frequencies of the peak surge, the tidal range, and the time during the tidal cycle.

An aggregation program was written to perform the computations. In addition to establishing the ordinates of the surge corresponding to a surge peak of given frequency, using the standard surge sequence, this program added these ordinates to those of the sinusoidal tide and established the maximum tide elevation. The program also obtained the exceedence probabilities of each maximum storm tide elevation.

These computations were made separately for hurricane and northeaster surges. The resulting frequency curves were combined by adding the frequencies obtained with each kind of storm for given storm tide elevations, as these are an independent series of events. It was found that the contribution of hurricane storm tides to the tide frequency distribution was considerably less important than that of the northeasters.

To obtain tide elevation frequencies at East Newark, a correlation was established between high waters there and at the Battery, New York, using the results of a COE study and a linear regression analysis (Reference 7). This correlation allowed the transposition of storm tide frequencies from the Battery to East Newark.

Finally, since the above computations resulted in estimated tides with respect to prevailing mean sea level, they were corrected by adding 0.6 foot to obtain elevations of equal frequency with respect to NGVD, for storm tides obtained using present (1980) mean sea level.

Frequency distribution curves for the Battery and East Newark were obtained through the above analyses. The storm tide elevations at the Battery and East Newark are shown in Table 2, "Storm Tide Elevations."

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TABLE 2 - STORM TIDE ELEVATIONS

RETURN PERIOD	1980 ESTIMATE (feet NGVD) THE BATTERY	EAST NEWARK
10	7.0	7.4
100	9.5	10.0
500	10.5	11.0

Since it was found that the downstream portion of Overpeck Creek is controlled by tidal elevations from Newark Bay, the tidal analysis presented above for Upper Newark Bay was used for this study. A summary of peak elevation-frequency relationships for Overpeck Creek is shown in Table 3, "Summary of Stillwater Elevations."

TABLE 3 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
NEWARK BAY				
(Tidal Flooding Affecting Overpeck Creek)				
At downstream corporate limits	4.7	6.1	6.7	9.1
Downstream of State Route 4	6.2	7.1	7.6	10.1

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Channel cross sections and partial overbank cross sections were obtained through field surveys. The overbanks were extended using topographic maps compiled from aerial photographs (Reference 11). In areas where topographic maps did not indicate most recent developments, full cross sections of the stream were taken. Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of those structures. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

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Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 12). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Overpeck Creek were obtained from the rating curve developed on the basis of the COE HEC-1 computer program (Reference 13). Starting water-surface elevations for Tributary to Overpeck Creek, Metzlers Creek, and Flat Rock Brook were calculated by a hydraulic section analysis to determine normal depths of flow.

Channel roughness factors (Manning's "n") used in the hydraulic computations were assigned based on field inspection of various cross sections in the flood plain areas. For Overpeck Creek, the channel "n" values ranged from 0.020 to 0.180, and the overbank "n" values ranged from 0.050 to 0.100. The channel "n" value for Tributary to Overpeck Creek was 0.033, and the overbank "n" values ranged from 0.060 to 0.080. For Metzlers Creek, the channel "n" values ranged from 0.015 to 0.033, while the overbank "n" values ranged from 0.040 to 0.090. The channel "n" values of Flat Rock Brook ranged from 0.015 to 0.034, and the overbank "n" values ranged from 0.060 to 0.140.

The analysis to obtain the tidal elevations in the Meadowlands was made using the LATIS Mathematical Model and a development configuration corresponding to 1981 plans by the Hackensack Meadowlands Development Commission (Reference 10). This represents the degree of encroachment incurred in the tidal swampland and its connecting streams.

The LATIS program was developed for the finite difference integration of the dynamic and continuity equations of gradually varied unsteady flow in a network of channels and reservoirs. The Meadowlands were divided into a series of nodes, with arbitrary boundaries which established the boundaries of such reservoirs. The reservoir areas within the node boundaries were planimetered, taking into consideration natural or fill ground elevations. Such areas were input as tables of areas versus elevations for each node.

The links were defined as reaches of streams in the Meadowlands connecting the nodes. These were considered open channels with hydraulic characteristics input as tables in terms of water-surface elevations at the nodes adjacent to each link. The model boundary conditions were

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defined by the tide at Node 1, which is located at the mouth of the Hackensack River in Upper Newark Bay, and 25 inflow links where fluvial inflow hydrographs were defined according to information provided by the New York District of the COE.

The boundary conditions for runs consisted of tides of a given frequency at Node 1 in conjunction with the 1-year fluvial hydrographs for all the inflow links. This combination was ascribed a frequency of occurrence equal to that assumed for the tide considering, as stated above, that the two events were independent.

Experience with the model demonstrated that flooding in the study area is predominantly tidal, and elevations resulting from a given tide are not sensitive to fluvial flows, with the exception of the Teterboro airport area. Therefore, the error in the assumption of complete independence of floods and tides is negligible.

The model was operated alternatively using hurricane and northeaster tides at Node 1. The frequency of a given tide elevation inland is equal to the sum of the frequencies of obtaining such an elevation from a hurricane or a northeaster storm tide at the mouth. Therefore, to obtain the 100- and 500-year elevations at each of the nodes of the model, storm tides of lesser frequencies at the mouth should be used for routing.

The routings were made using hurricane and northeaster tides of 100- and 200-year recurrence intervals. The resulting elevations at each of the nodes were plotted on log paper versus the individual frequencies of the tides at the mouth, from which two frequency distribution straight lines were drawn for each node. It was immediately found that hurricane frequency does not have a noticeable influence beyond Penhorn Creek.

The combined frequency curves could be obtained by the addition of frequencies for each elevation at each node. The 100- and 500-year elevations resulted from interpolation of the resulting graphs for such periods.

In addition, 10-year northeaster and hurricane tides were routed through the model and from these runs, the 10- and 50-year elevations were obtained. These runs also resulted in the estimates for the 50-, 100- and 500-year floods in the Teterboro area.

All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

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The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed and do not fail.

For the areas studied by approximate methods, the extent of the 100-year flood was based on depth-discharge-frequency relationships for non-coastal plain sites in New Jersey for the mean annual flood (Reference 14). Information supplied by local officials and field investigations were used as supplements.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 11). The 100- and 500-year flood boundaries for the downstream portion of Overpeck Creek affected by tidal flooding were delineated using topographic maps compiled from aerial photographs (Reference 15).

For the streams studied by approximate methods, the boundary of the 100-year flood was delineated using the Flood Hazard Boundary Map for Englewood and USGS flood-prone area maps (References 16 and 17).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of

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flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 4).

On Metzlers Creek, the floodway in the vicinity of the Glenbrook culvert does not follow the culvert, which runs directly under the road. The floodway location resulting from flow over and around the culvert runs through a low area adjacent to the Glenbrook culvert.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for Overpeck Creek extend beyond the corporate limits.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 0.2 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain developments are shown in Figure 2.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 4 for certain downstream cross sections of Overpeck Creek, Metzlers Creek, and Flat Rock Brook are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Overpeck Creek								
A	21,879	69/59[2]	432	3.5	6.7	6.3[3]	6.5	0.2
B	22,735	229/210[2]	888	1.7	6.9	6.9	7.0	0.1
C	23,235	218/200[2]	772	1.9	7.3	7.3	7.4	0.1
D	23,745	346/185[2]	1,263	1.2	7.4	7.4	7.5	0.1
E	24,190	201	823	1.8	7.5	7.5	7.6	0.1
F	25,382	60	480	3.1	7.8	7.8	7.9	0.1
G	25,982	60	448	3.3	7.8	7.8	7.9	0.1
H	26,535	145	422	3.5	8.2	8.2	8.2	0.0
I	28,070	264	576	2.1	10.2	10.2	10.3	0.1
J	29,325	64	182	4.6	13.6	13.6	13.7	0.1
K	30,790	65	434	1.9	23.1	23.1	23.1	0.0
L	31,407	60	277	2.6	24.5	24.5	24.5	0.0
M	32,395	*	103	7.0	24.5	24.5	24.6	0.1
N	32,650	*	63	11.4	25.1	25.1	25.2	0.1
O	33,255	*	84	8.6	29.4	29.4	29.4	0.0
P	33,965	*	60	12.0	33.0	33.0	33.0	0.0
Q	34,630	*	74	9.7	41.0	41.0	41.0	0.0
R	34,975	*	96	7.5	45.5	45.5	45.5	0.0
S	35,285	50	148	4.9	57.3	57.3	57.3	0.0
T	35,795	*	72	9.9	61.4	61.4	61.4	0.0
U	37,185	*	74	5.1	83.9	83.9	83.9	0.0

[1]Feet above confluence with Hackensack River

*Floodway coincident with channel banks

[2]Width/width within corporate limits

[3]Elevation computed without consideration of backwater from Newark Bay

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

FLOODWAY DATA

OVERPECK CREEK

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Tributary to Overpeck Creek								
A	690	40	176	3.1	8.8	8.8	9.0	0.2
B	1,300	25	162	3.4	9.8	9.8	10.0	0.2
C	1,620	18	91	6.0	10.5	10.5	10.7	0.2
Metzlers Creek								
A	1,225	31	132	5.3	10.0	8.6[2]	8.7	0.1
B	1,875	43	185	3.8	10.2	9.7[2]	9.7	0.0
C	2,525	20	68	10.4	10.3	10.3	10.3	0.0
D	3,010	39	172	4.1	12.3	12.3	12.3	0.0
E	3,240	41	173	4.1	12.6	12.6	12.6	0.0
F	3,800	31	138	4.7	13.0	13.0	13.0	0.0
G	4,060	36	136	4.7	13.4	13.4	13.4	0.0
H	4,620	27	65	8.8	15.2	15.2	15.2	0.0
I	5,488	99	71	4.3	22.6	22.6	22.7	0.1
J	6,115	217	62	5.0	25.0	25.0	25.0	0.0
K	6,640	24	61	9.2	28.7	28.7	28.7	0.0
L	6,791	21	77	7.3	30.3	30.3	30.3	0.0
M	7,026	*	46	12.3	37.3	37.3	37.3	0.0
N	7,371	116	536	1.1	44.4	44.4	44.6	0.2
O	7,571	33	125	4.5	44.6	44.6	44.8	0.2
P	7,941	21	59	9.6	45.5	45.5	45.5	0.0
Q	8,956	28	65	8.7	55.1	55.1	55.1	0.0

[1]Feet above confluence with Overpeck Creek

[2]Elevation computed without consideration of backwater from Overpeck Creek

*Floodway coincident with channel banks

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ

(BERGEN CO.)

FLOODWAY DATA

TRIBUTARY TO OVERPECK CREEK AND METZLERS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Flat Rock Brook								
A	2,170	35	247	5.3	6.7	6.5[2]	6.6	0.1
B	4,715	28	138	9.5	26.7	26.7	26.7	0.0
C	4,890	43	131	10.0	28.0	28.0	28.0	0.0
D	5,145	34	185	7.1	30.2	30.2	30.3	0.1
E	5,280	97	230	5.7	31.0	31.0	31.0	0.0
F	5,565	78	200	6.6	32.3	32.3	32.5	0.2
G	5,855	41	166	7.9	36.8	36.8	37.0	0.2
H	6,290	42	131	10.1	54.9	54.9	54.9	0.0
I	6,510	38	126	10.5	75.4	75.4	75.4	0.0
J	6,840	33	126	10.4	96.6	96.6	96.6	0.0
K	7,245	34	121	10.9	111.7	111.7	111.7	0.0
L	7,655	35	132	10.0	124.3	124.3	124.4	0.1
M	7,945	90	243	5.4	127.3	127.3	127.3	0.0
N	8,660	113	274	4.8	129.5	129.5	129.7	0.2
O	8,770	98	275	4.8	130.0	130.0	130.2	0.2

[1]Feet above confluence with Overpeck Creek

[2]Elevation computed without consideration of backwater from Overpeck Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

FLOODWAY DATA

FLAT ROCK BROOK

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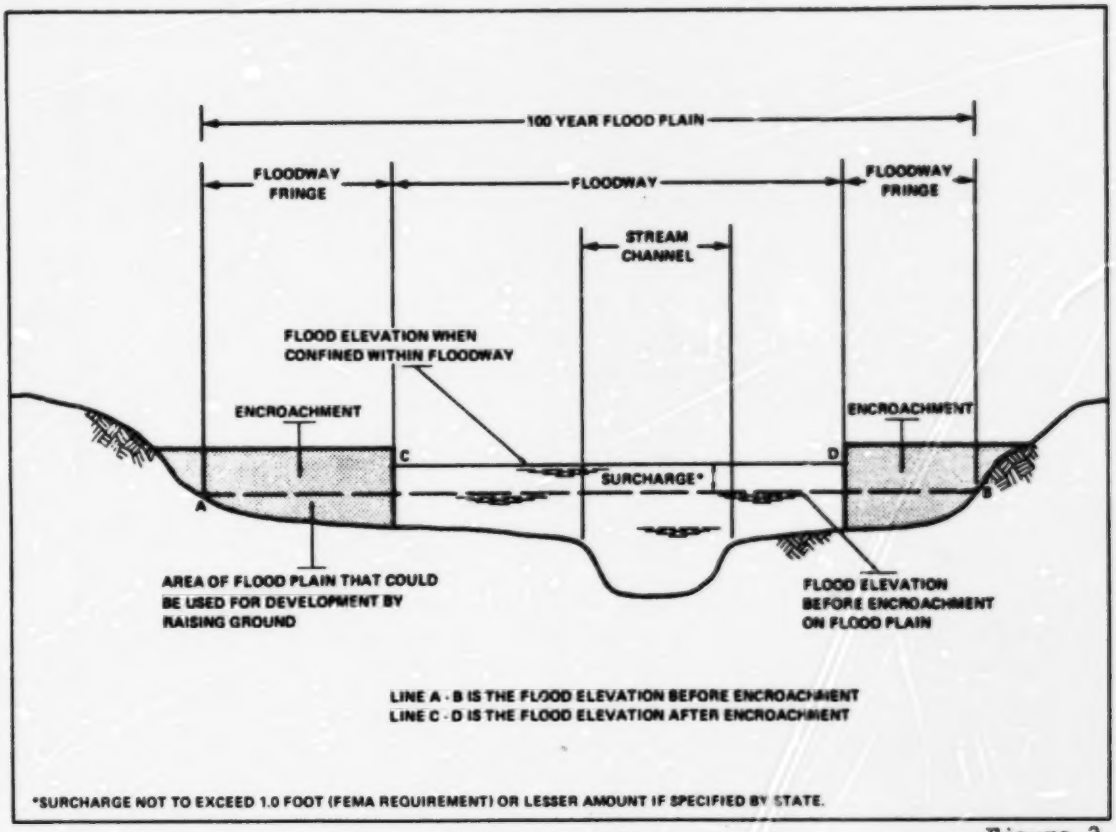
100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 2.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Englewood.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

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Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the riverine flooding sources of the City of Englewood are shown on the Flood Profiles (Exhibit 1) and summarized in Table 5.

In tidal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. Using these criteria, one reach was required for the tidal flooding source of the City of Englewood. The location of this reach is shown on the Flood Insurance Rate Map and summarized in Table 5.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A3, A4, and A10:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.

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FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Newark Bay (Tidal Flooding affecting Overpeck Creek)	01,02	-2.1	-0.7	+0.5	020	A4	7
Overpeck Creek							
Reach 1	01,02	-1.5	-0.5	+1.8	015	A3	Varies
Reach 2	01	-4.9	-2.1	+1.6	050	A10	Varies
Reach 3	01	-1.3	-0.3	+1.1	015	A3	Varies
Tributary to Overpeck Creek							
Reach 1	02	-1.7	-0.8	+2.7	015	A3	Varies
Metzlers Creek							
Reach 1	02	-0.9	-0.3	+0.9	010	A2	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD,NJ
(BERGEN CO.)

FLOOD INSURANCE ZONE DATA

NEWARK BAY, OVERPECK CREEK, TRIBUTARY TO OVERPECK CREEK,AND METZLERS CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Flat Rock Brook							
Reach 1	02	-2.1	-0.9	+1.3	020	A4	Varies
Reach 2	02	-1.2	-0.4	+1.3	010	A2	Varies
Reach 3	02	-1.5	-0.7	+1.4	015	A3	Varies
Reach 4	02	-1.8	-0.6	+1.3	020	A4	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

FLOOD INSURANCE ZONE DATA

FLAT ROCK BROOK

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Zone B: Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding; not subdivided.

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 5.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Englewood is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Insurance Studies for the Boroughs of Bergenfield, Leonia, and Tenafly and the Township of Teaneck have been published (References 18, 19, 20, and 21). The results of this study will not be in agreement with the results of those studies due to the revised hydrologic and hydraulic analyses and changes to the floodways and flood boundaries for Overpeck Creek and Metzlers Creek in this study.

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region II Office, 26 Federal Plaza, Room 19-100, New York, New York 10278.

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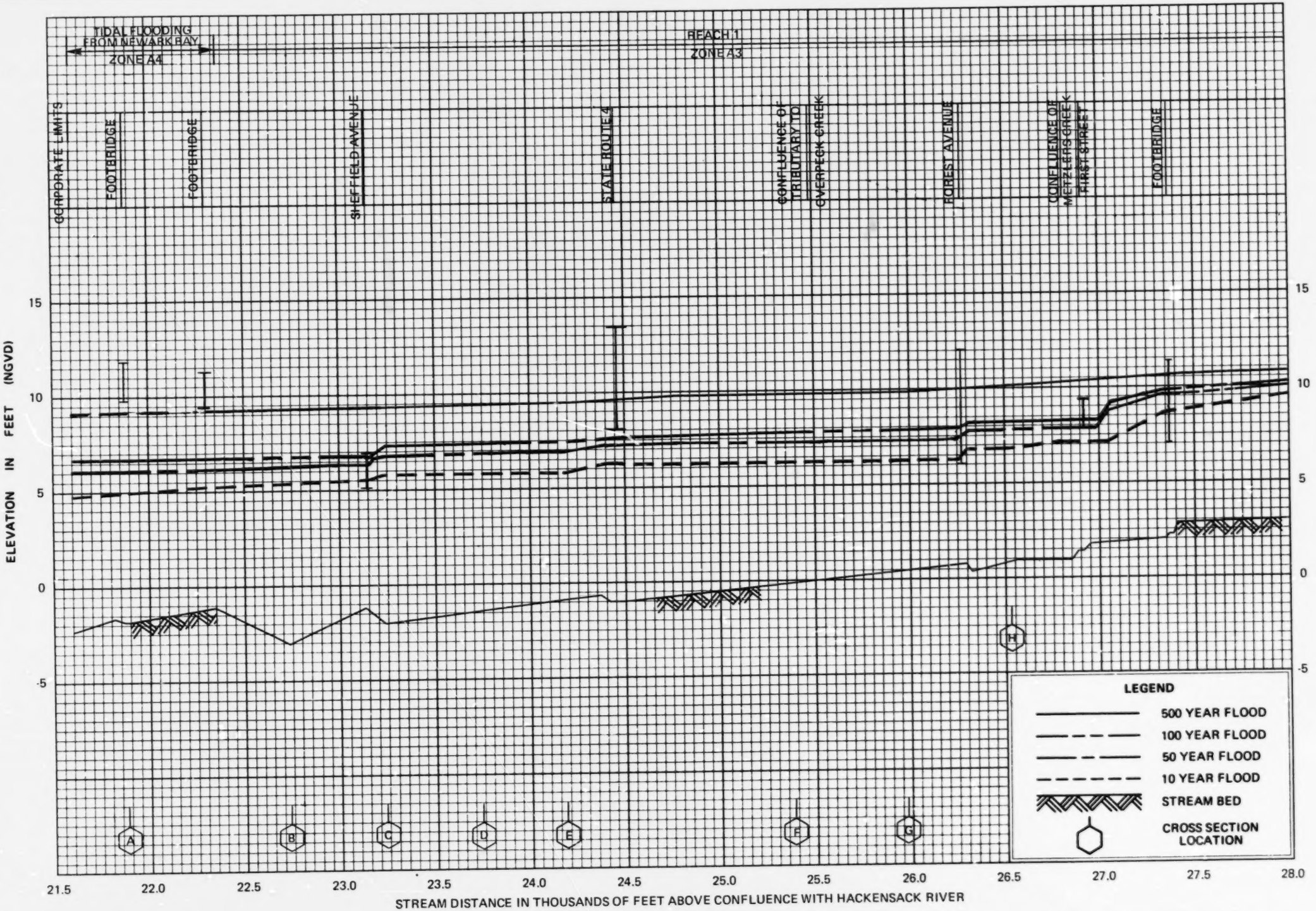

FLOOD PROFILES

OVERPECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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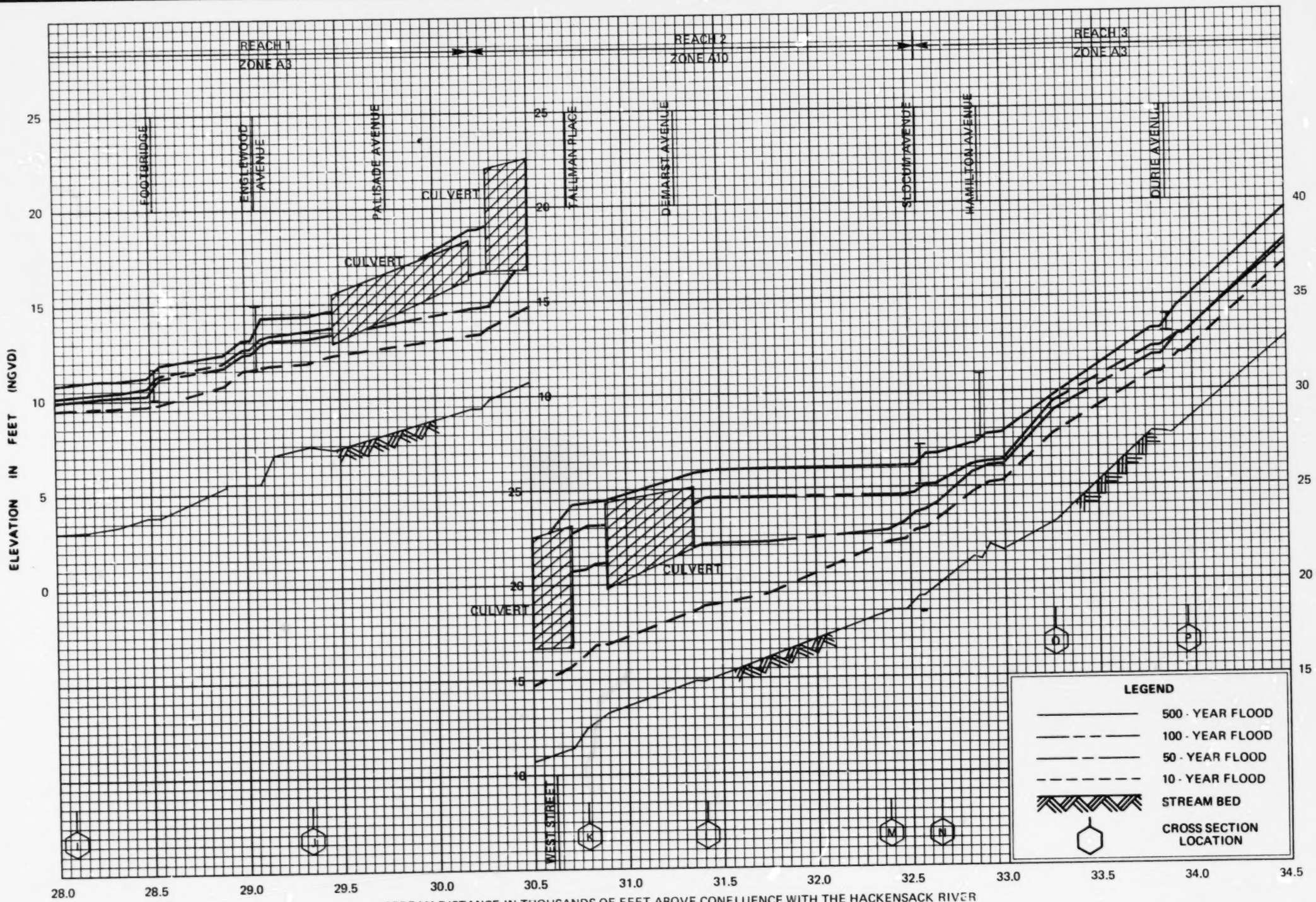

FLOOD PROFILES

OVERPECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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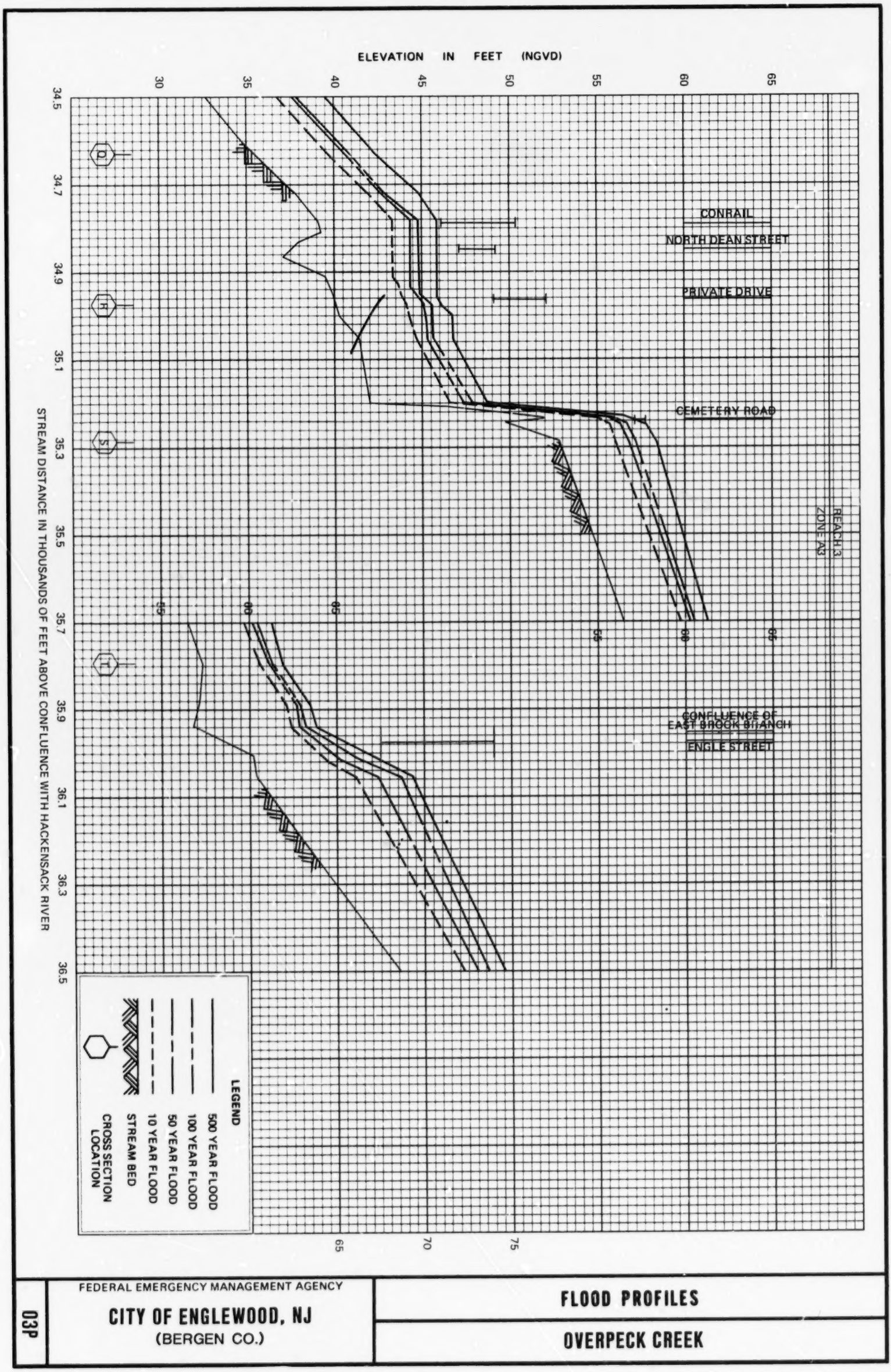

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CITY OF ENGLEWOOD, NJ

(BERGEN CO.)

FLOOD PROFILES

OVERPECK CREEK

03P

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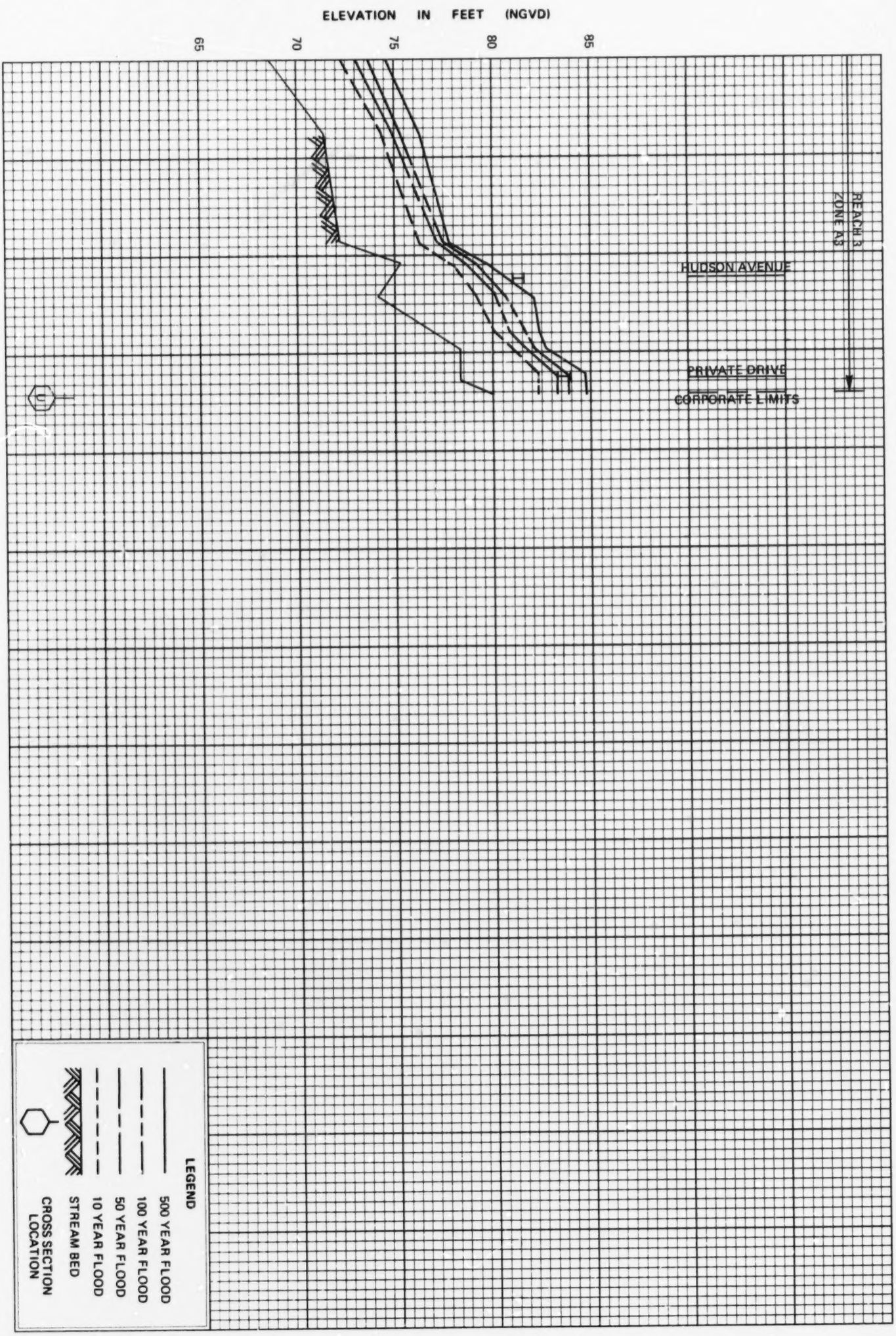

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CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

FLOOD PROFILES

OVERPECK CREEK

04P

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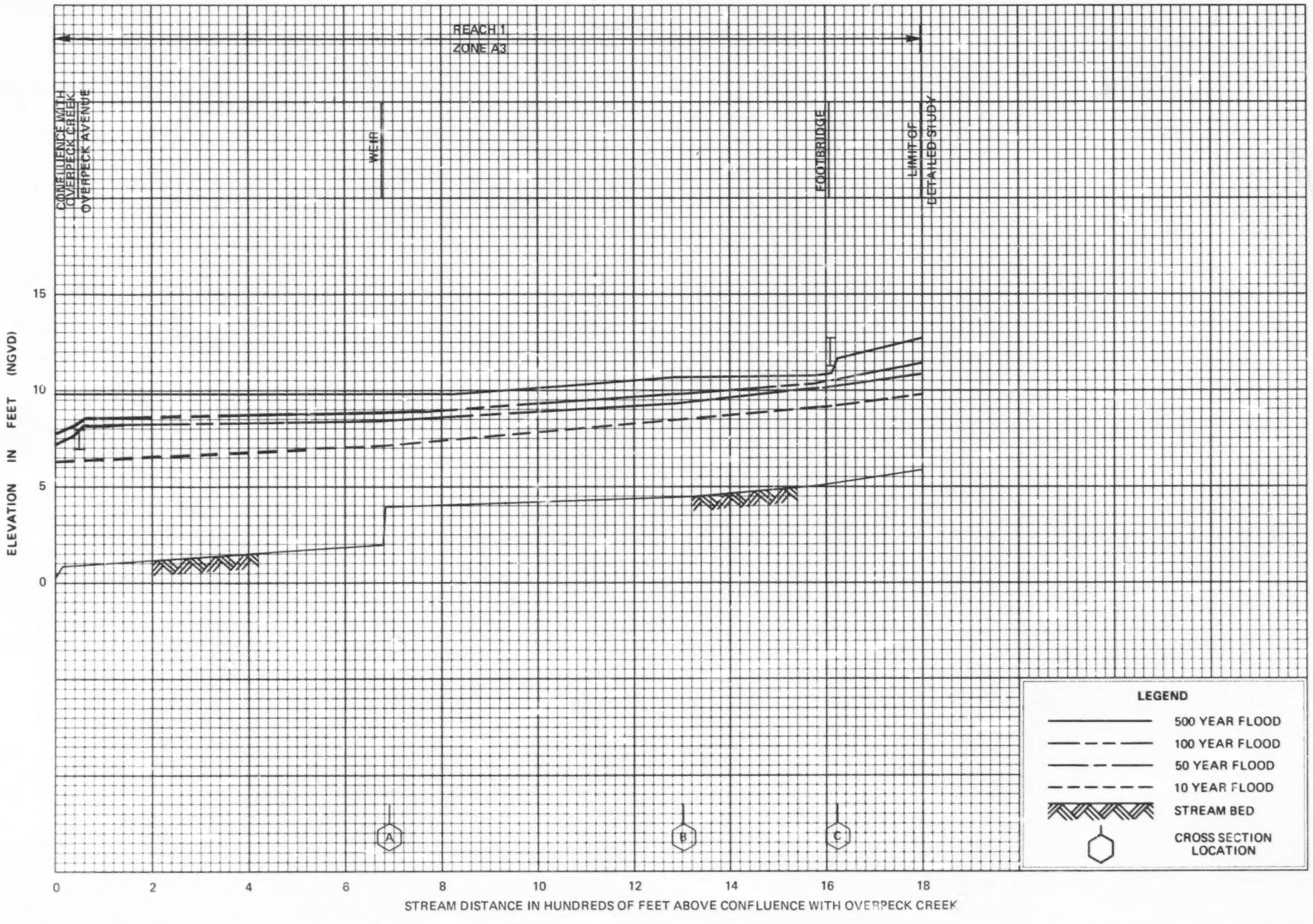

FLOOD PROFILES

TRIBUTARY TO OVERPECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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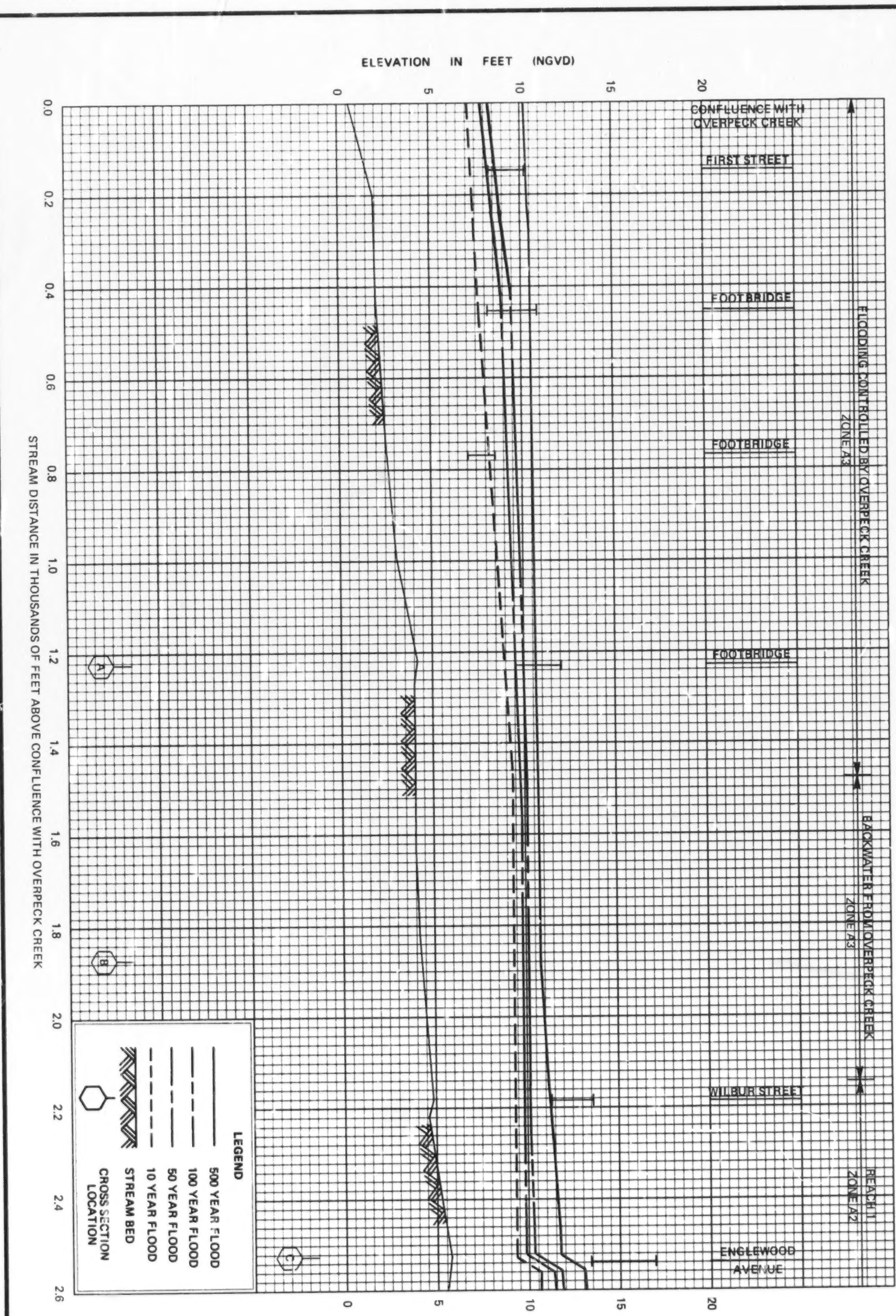

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

FLOOD PROFILES

METZLERS CREEK

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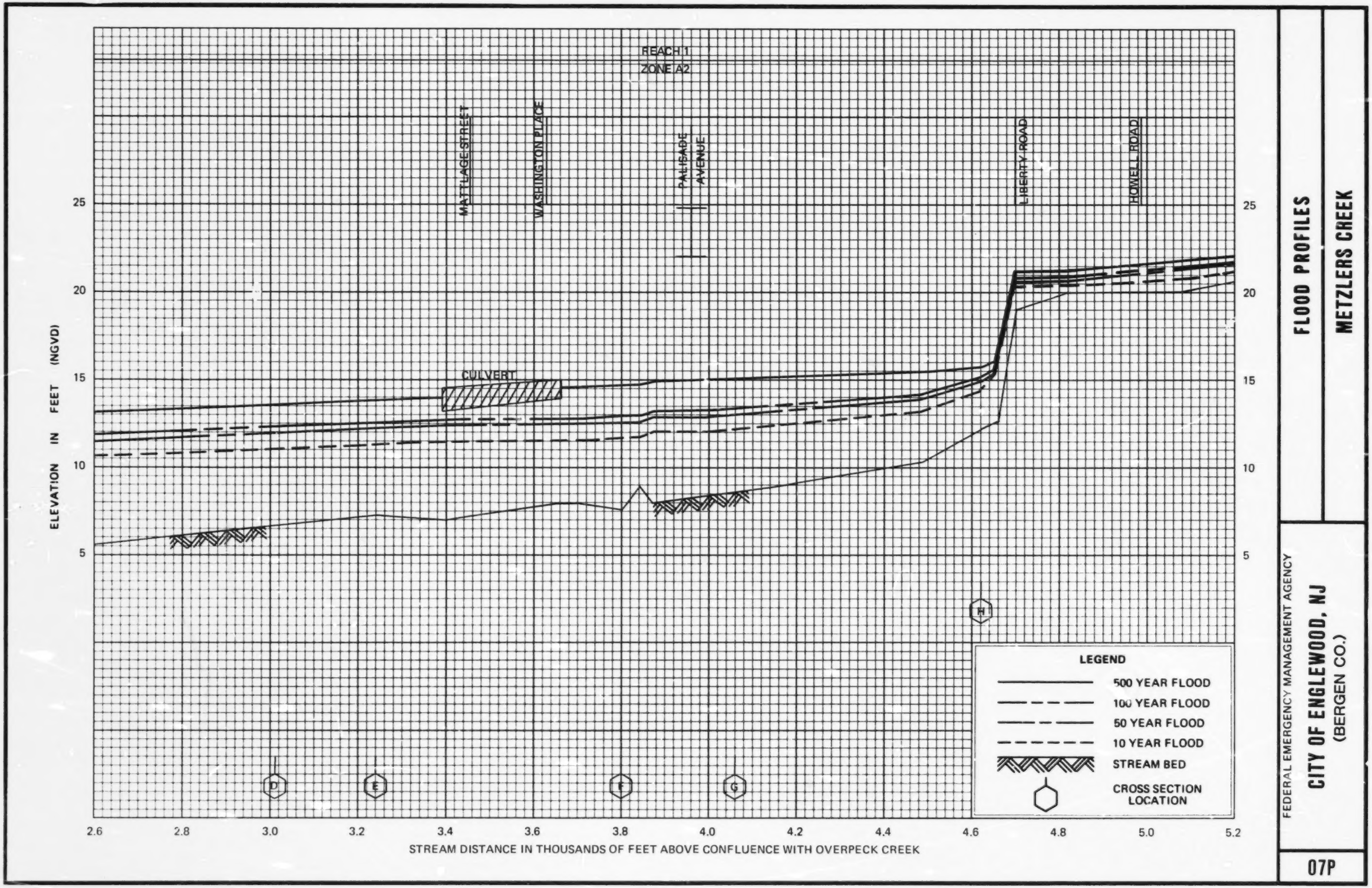

FLOOD PROFILES

METZLERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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REACH 1
ZONE A2

TYRON AVENUE

FOOTBRIDGE

FOOTBRIDGE
SPILLWAY

ELEVATION IN FEET (NGVD)

50
45
40
35
30
25
20

LEGEND

500 YEAR FLOOD
100 YEAR FLOOD
50 YEAR FLOOD
10 YEAR FLOOD
STREAM BED
CROSS SECTION LOCATION

I J K L M N O

5.2 5.4 5.6 5.8 6.0 6.2 6.4 6.6 6.8 7.0 7.2 7.4 7.6 7.8

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CONFLUENCE WITH OVERPECK CREEK

FLOOD PROFILES

METZLERS CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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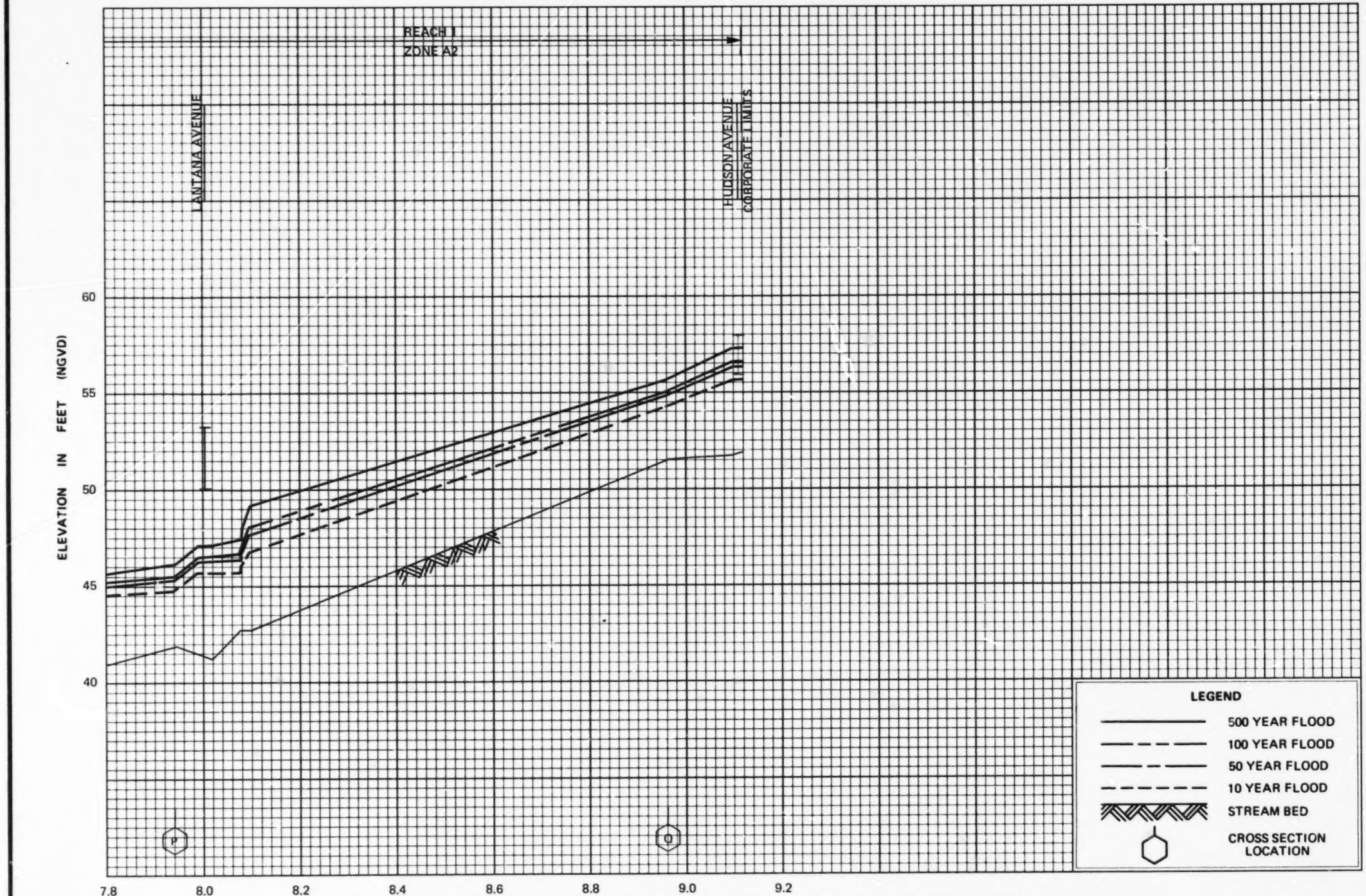

FLOOD PROFILES

METZLERS CREEK

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CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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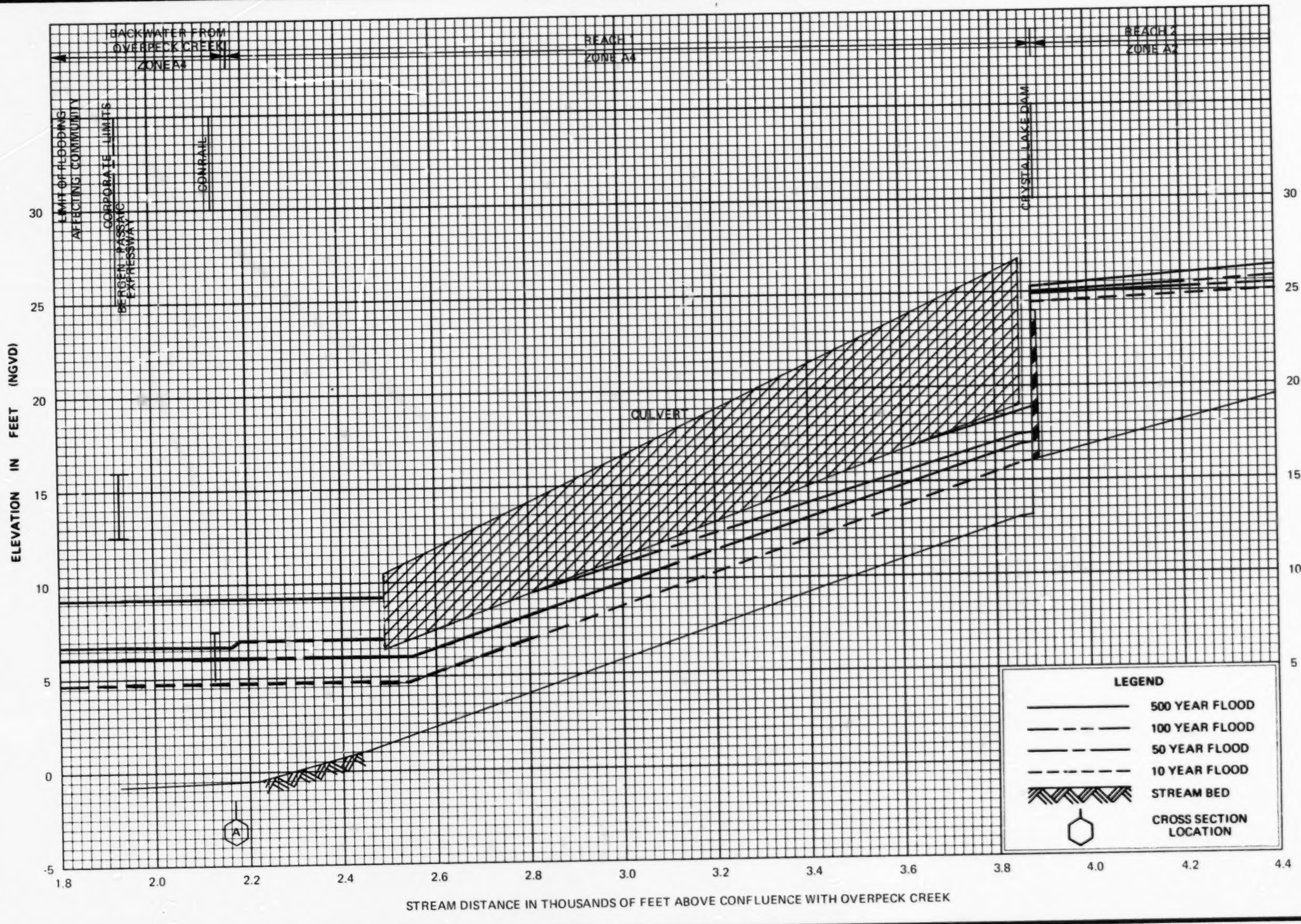

FLOOD PROFILES

FLAT ROCK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

10P

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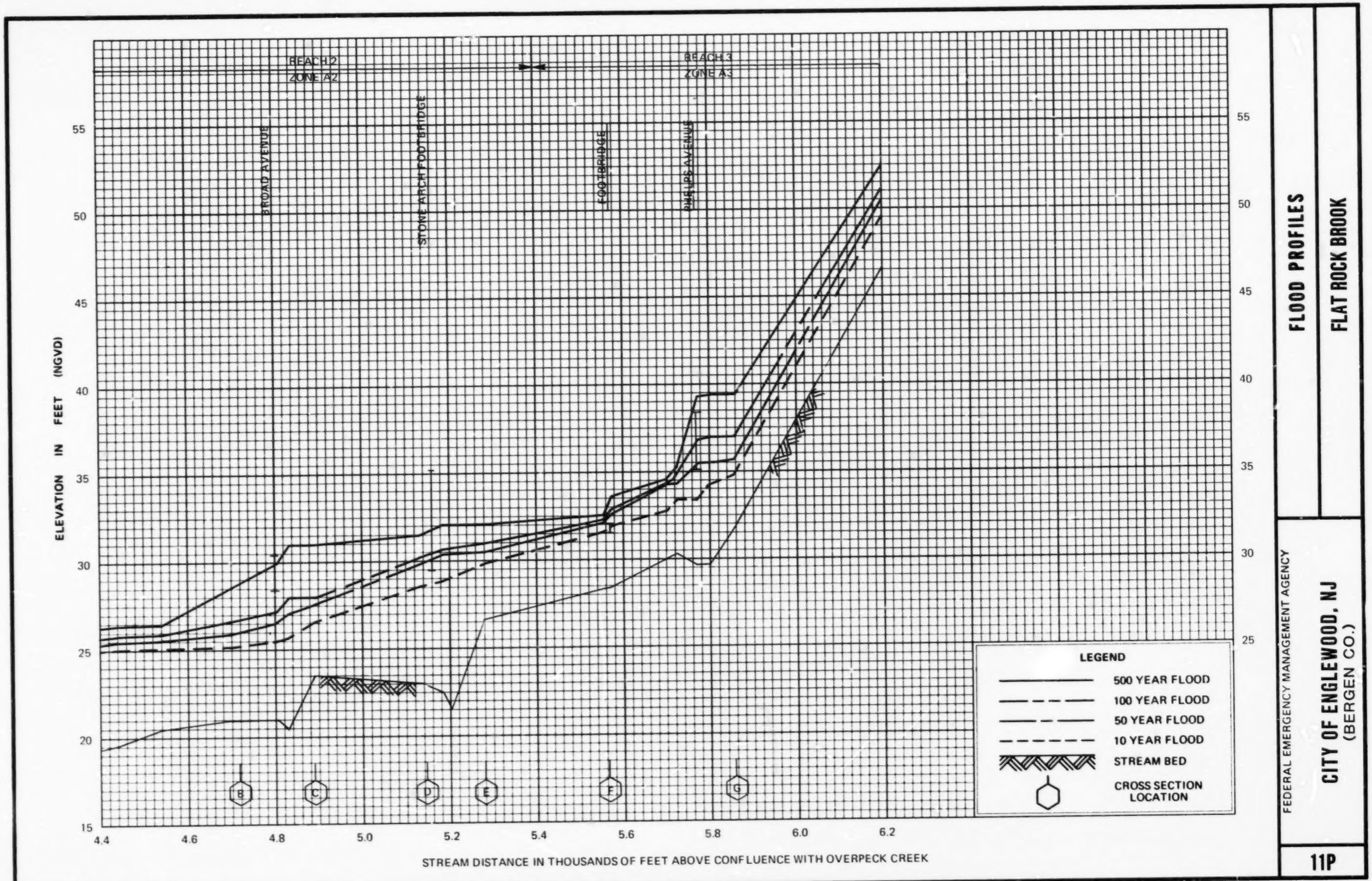

FLOOD PROFILES

FLAT ROCK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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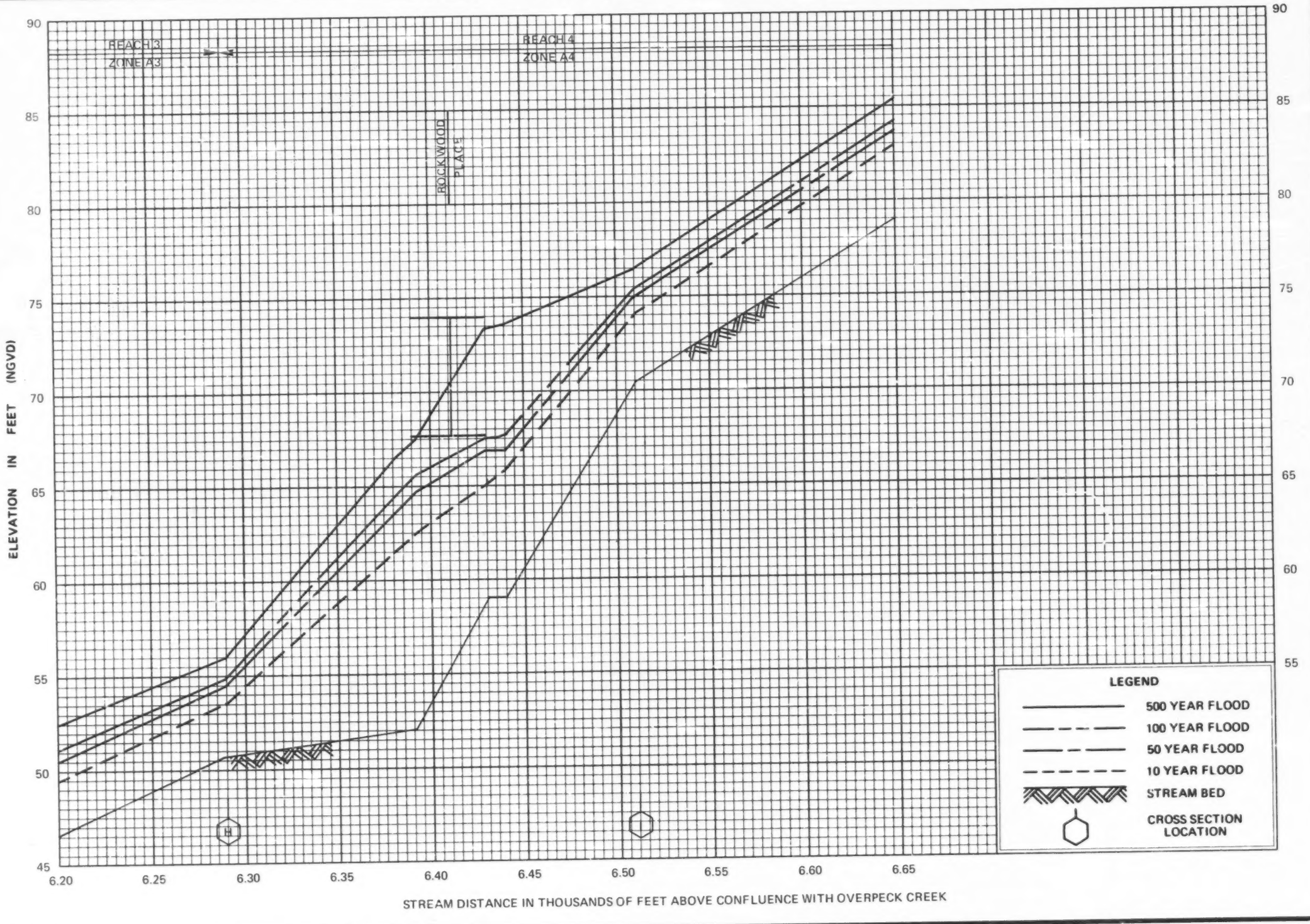

FLOOD PROFILES

FLAT ROCK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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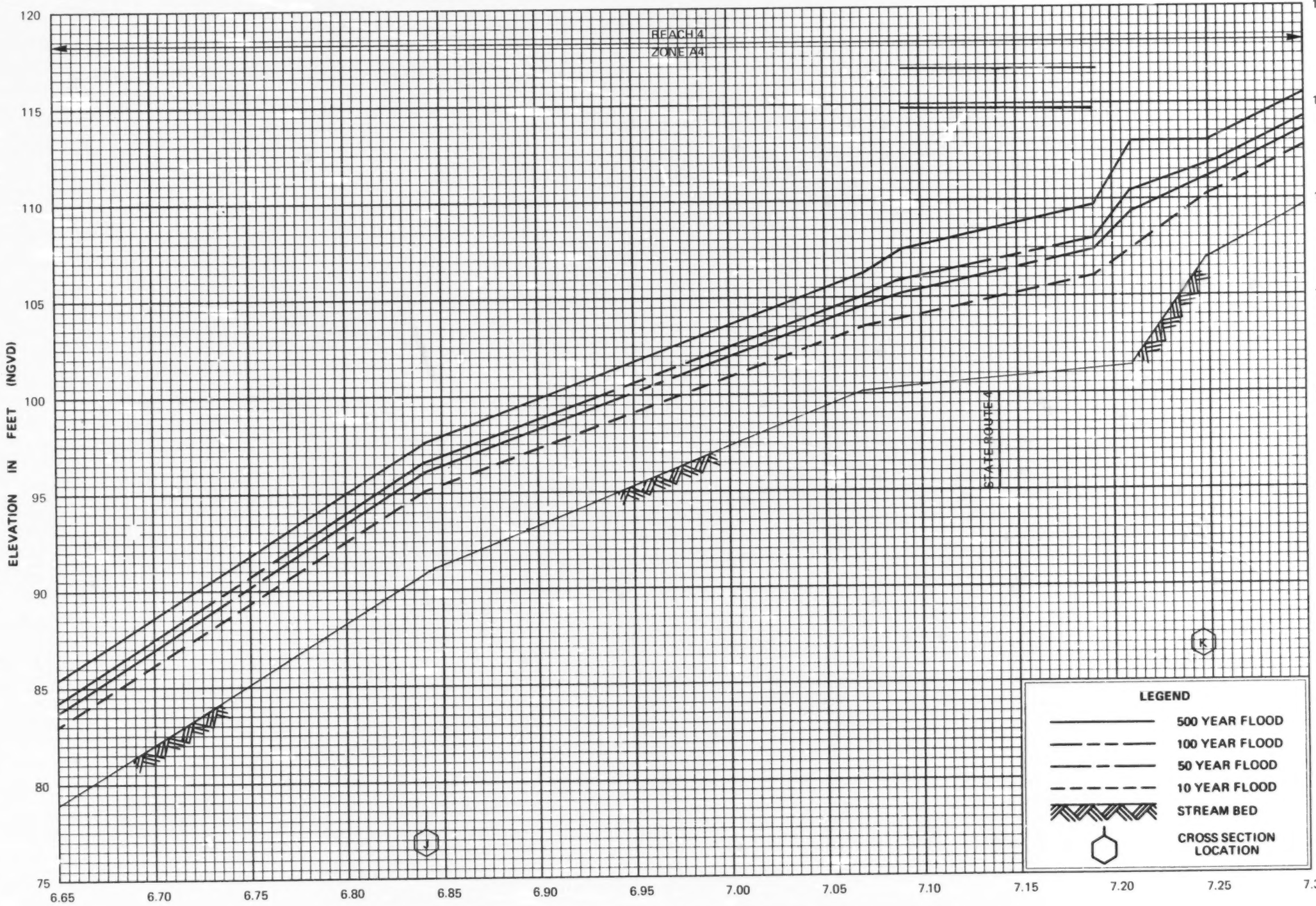

FLOOD PROFILES

FLAT ROCK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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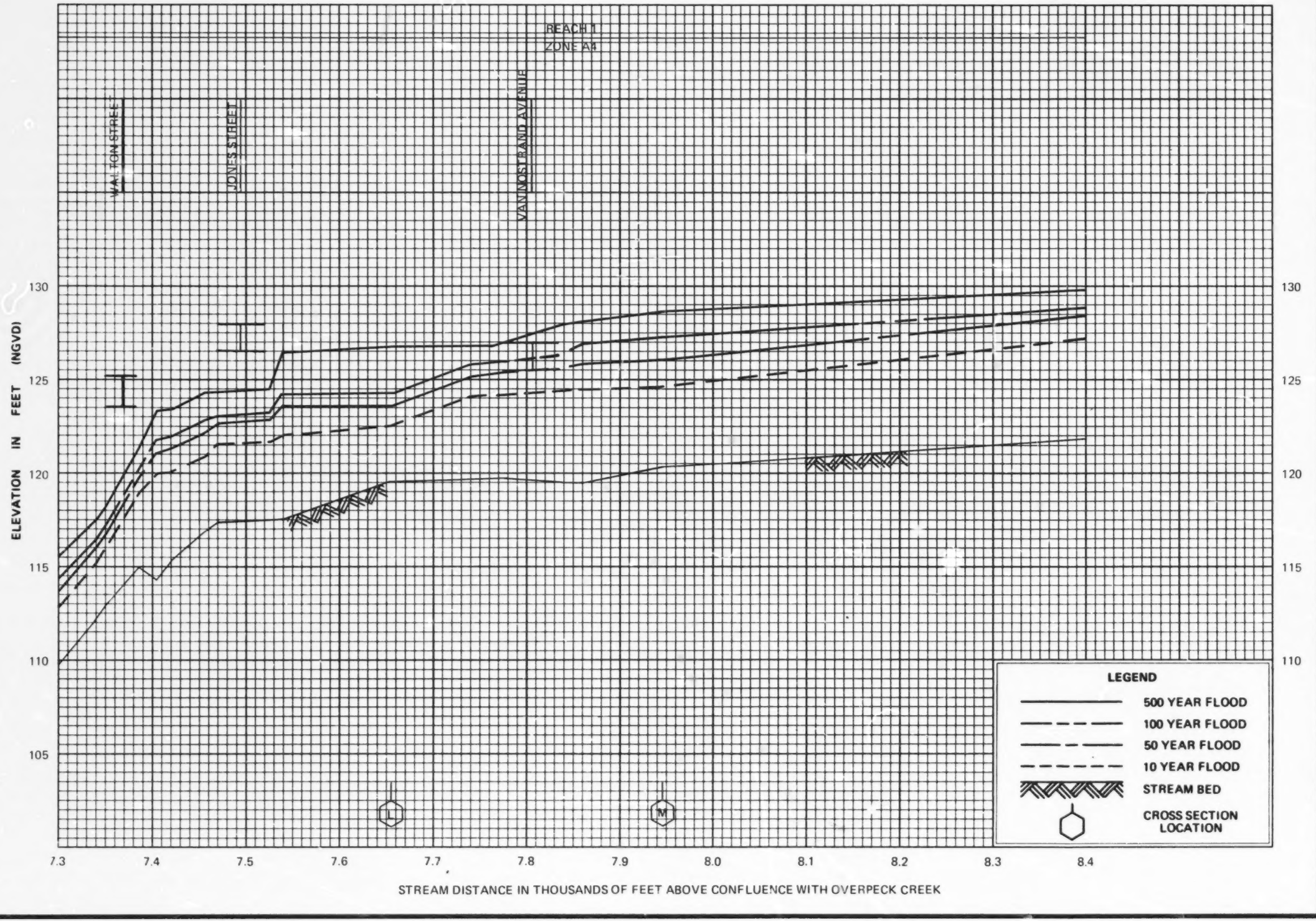

FLOOD PROFILES

FLAT ROCK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF ENGLEWOOD, NJ
(BERGEN CO.)

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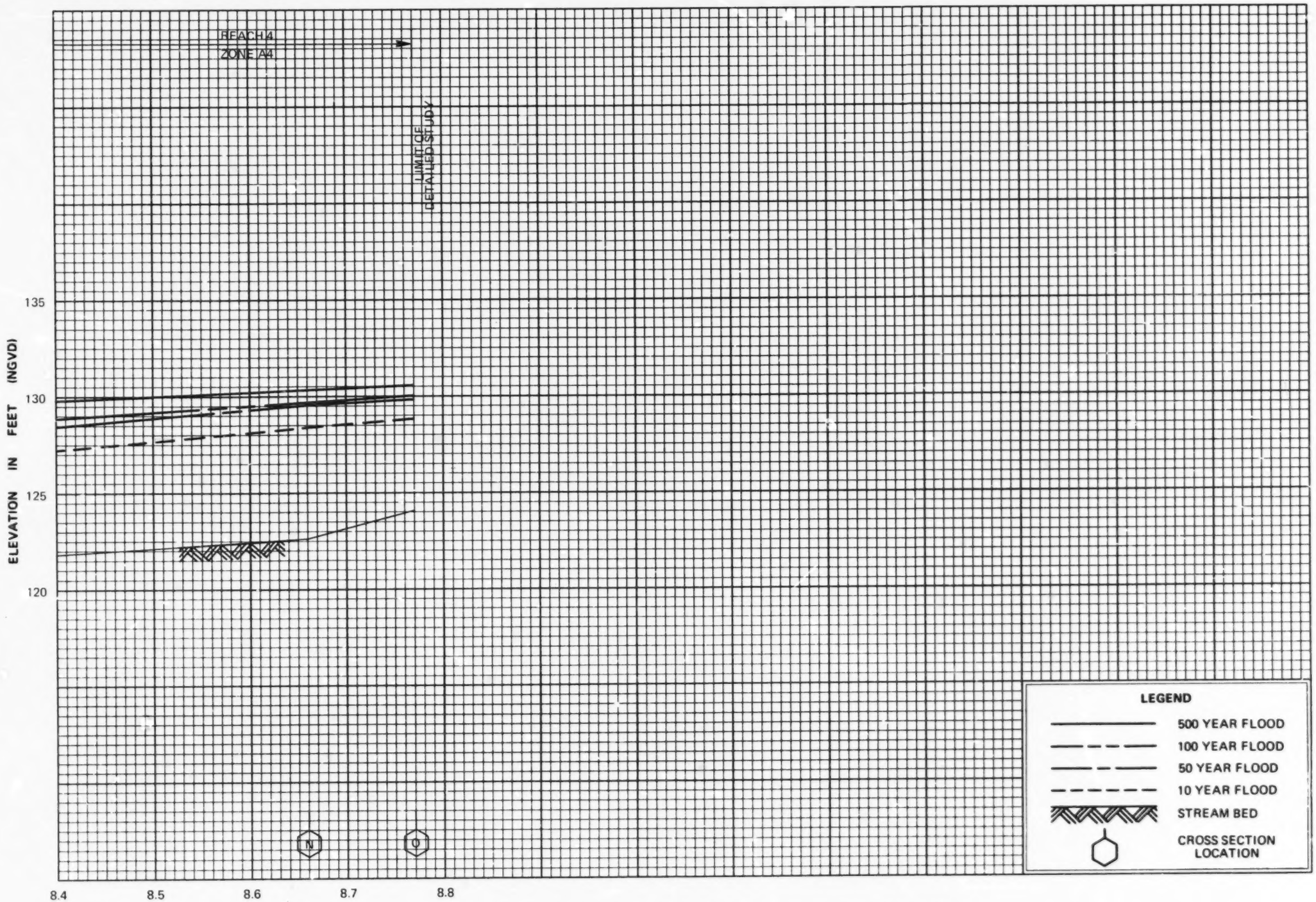

FLOOD PROFILES

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